

Bendix® MC-12™ Modulator Controller Assembly

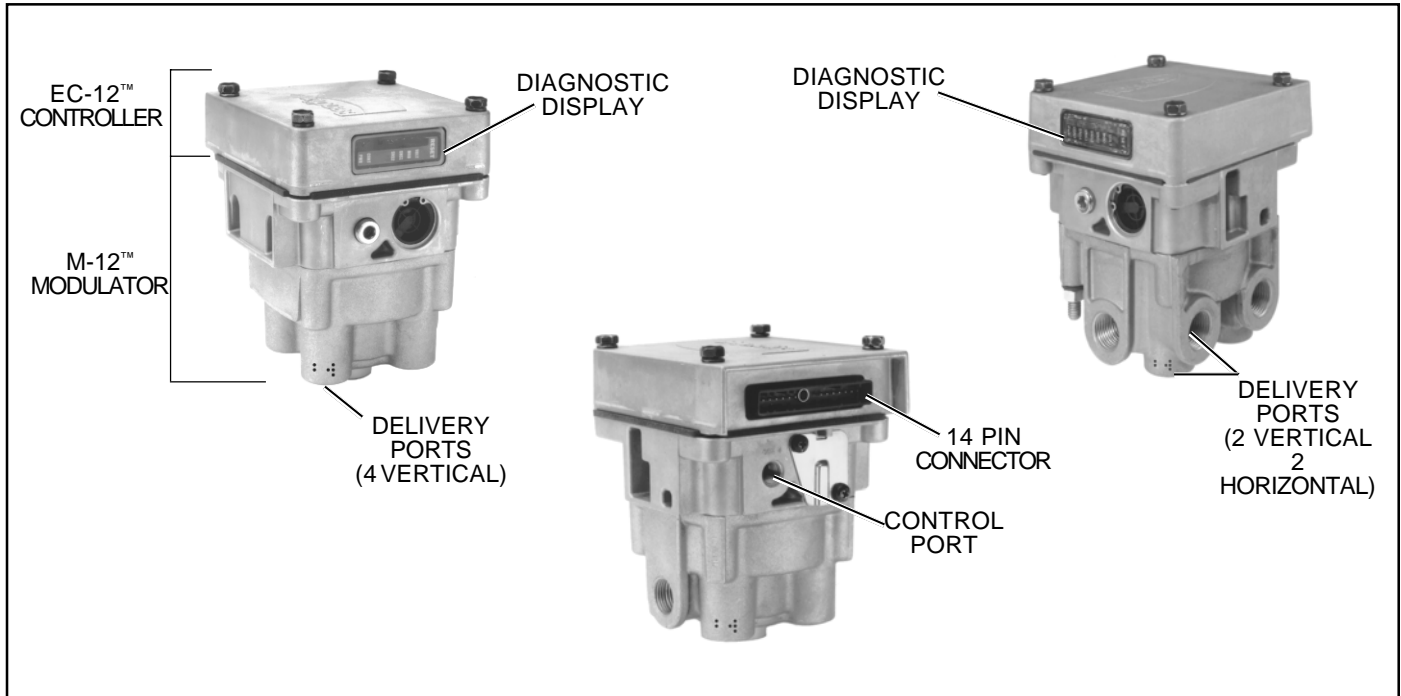


FIGURE 1 - MC-12™ MODULATOR CONTROLLER ASSY.

DESCRIPTION

The Bendix® MC-12™ modulator trailer antilock system is designed to improve vehicle stability by reducing wheel lock up during aggressive braking. Like Bendix's tractor antilock, the trailer system can provide single or tandem axle control. The main component is nipple mounted to a reservoir, so the system requires no special trailer modifications.

The trailer antilock system consists of the following: MC-12™ modulator/controller, WS-20™ wheel speed sensors, electrical connectors and wiring. The MC-12™ modulator is the main component. It houses the EC-12™ electronic controller and the M-12™ modulator, which contains solenoids and a standard relay valve.

The EC-12™ controller houses the electronics that regulate the trailer antilock system and also incorporates a diagnostic display window and a 14 pin connector.

The EC-12™ controller mounts to the M-12™ modulator with four bolts, and it is internally connected to the solenoids by a four pin connector. The solenoids are the interface between the EC-12™ controller electronic signals and the pneumatically operated modulator. Sensors mounted at the

wheel end send wheel speed information to the EC-12™ controller through the 14 pin connector. The sensors are actually AC generators. They house magnets, which create a magnetic field. When the field is interrupted by an irregular surface, such as a tone ring, AC voltage is produced. The frequency of voltage increases or decreases as wheel speed increases or decreases.

During normal, non antilock operation, the M-12™ modulator's inlet solenoid is open, and the exhaust solenoid is closed. In this condition, the M-12™ modulator functions as a regular R-12™ relay valve. It receives a control signal from the foot valve, which passes through the open inlet solenoid and causes the brakes to apply in proportion to the amount of control pressure.

If wheel lock up is impending, the EC-12™ controller commands the solenoids to modulate brake chamber pressure on the axle(s) in which the system is installed.

The MC-12™ modulator/controller receives its power from the vehicle's stop light circuit (pin 4 on the standard seven pin connector—red). The power enters the EC-12™ controller at pin A and (optionally) pin B from the auxiliary terminal (blue wire) of the trailer's 7 pin connector.

| Seven Pin Connector | Conductor (Wire No.) | Antilock Connector Letter | Wire Color | Lamp and Signal Circuits | Wire Gauge | | |
|---------------------------|----------------------------|---------------------------------|---------------|--|------------------|--------|--------|
| | | | | | Single/ Dolly | Double | Triple |
| 1 | 1 | C | White | Ground Return To Towing Vehicle | 12 | 10 | 8 |
| 2 | 2 | - | Black | Clearance, Side Marker and Identification Lamps | 12 | 12 | 12 |
| 3 | 3 | - | Yellow | Left Hand Turn Signal and Hazard Signal Lamps | 12 | 12 | 12 |
| 4 | 4 | - | Red | Stop Lamps | 10 | 10 | 10 |
| 5 | 5 | - | Green | Right Hand Turn Signal and Hazard Signal Lamps | 12 | 12 | 12 |
| 6 | 6 | - | Brown | Tail, Clearance, Side Marker and License Plate Lamps | 12 | 12 | 12 |
| 7 | 7 | B* | Blue | Auxiliary, Dome, Etc. or constant Antilock power | 12 | 12 | 12 |
| 4 | 9 | A | Red | Antilock Power From Stop Lamp | 10 | 10 | 10 |
| - | 8 | D | Yellow | Trailer Mounted Status Light | 14/16 | 14/16 | 14/16 |
| - | 10/11 | N/P | - | Wheel Speed Sensor | 16/18 | 16/18 | 16/18 |
| - | 12/13 | M/L | - | Wheel Speed Sensor | 16/18 | 16/18 | 16/18 |

The relay illustrated to the right is used when a tractor, dash mounted status lamp for the trailer antilock system is desired. Like the trailer mounted status lamp, this is an option and is not required.

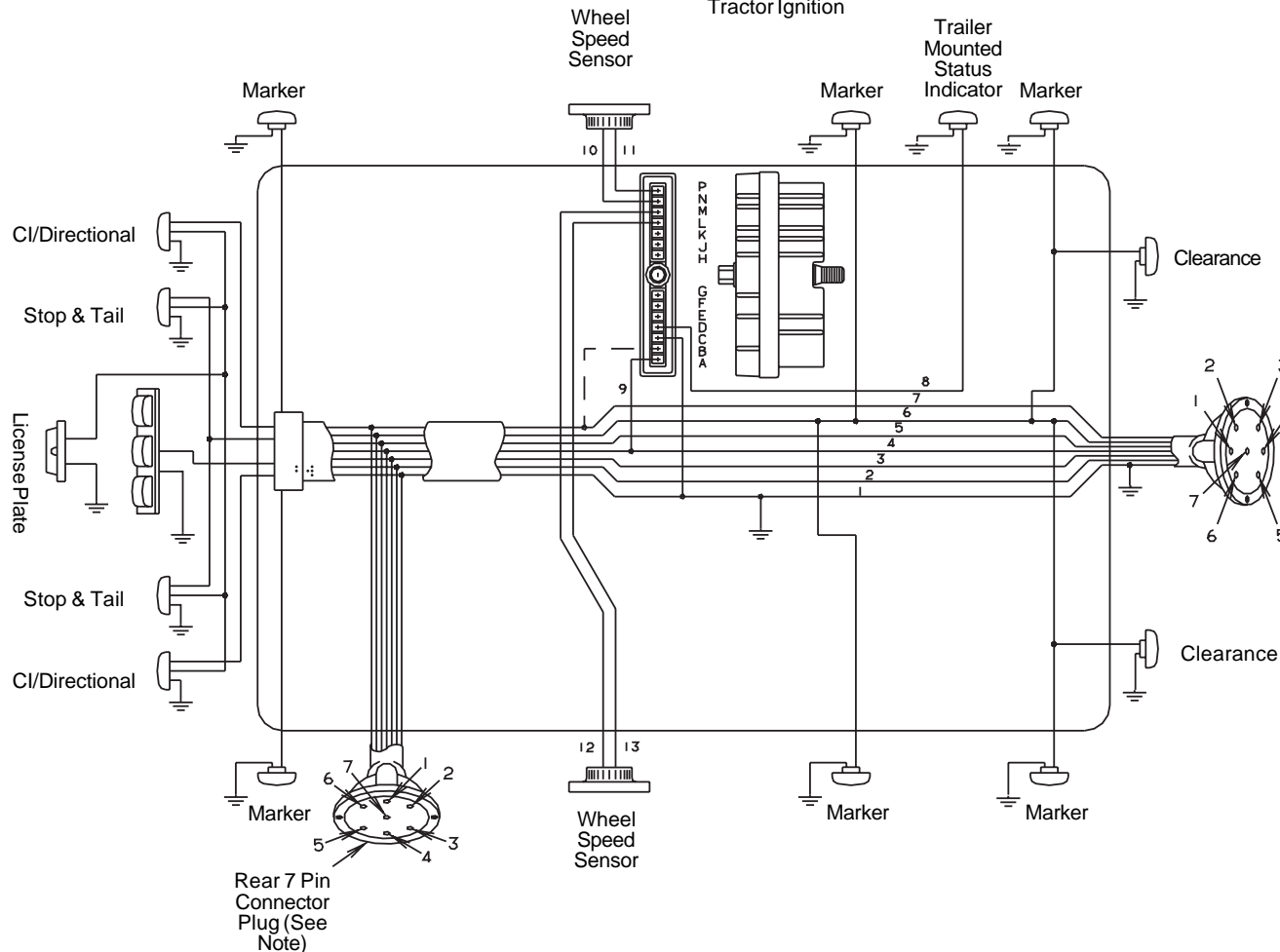


FIGURE 2 - MC-12™ MODULATOR TRAILER SYSTEM WIRING SCHEMATIC

System ground (pin 1 on the seven pin connector—white) enters the MC-12™ modulator at pin C.

Each wheel speed sensor sends the MC-12™ modulator its AC signal through a pair of wires. The MC-12™ modulator pins for the sensors are L-M and N-P.

The MC-12™ modulator can send a +12v failure signal to the optional trailer mounted status light through pin D. The status light indicates the condition of the trailer antilock system. In addition, the MC-12™ modulator can send a grounding signal through its pin J to an optional tractor, dash mounted status lamp. During start up, when the trailer brakes are actuated, trailer antilock immediately runs a self check. The status light flashes once and then goes off. Should a problem occur, the antilock system disengages and returns to normal R-12™ relay valve operation.

If the status light comes on and remains on when the trailer brakes are actuated, a system problem has occurred. The EC-12™ controller contains a diagnostic window, which

directs the driver to the problem area. A series of LEDs on the EC-12™ controller indicate the status of power, EC-12™ controller, wheel speed sensors, M-12™ modulator solenoids, or voltage level.

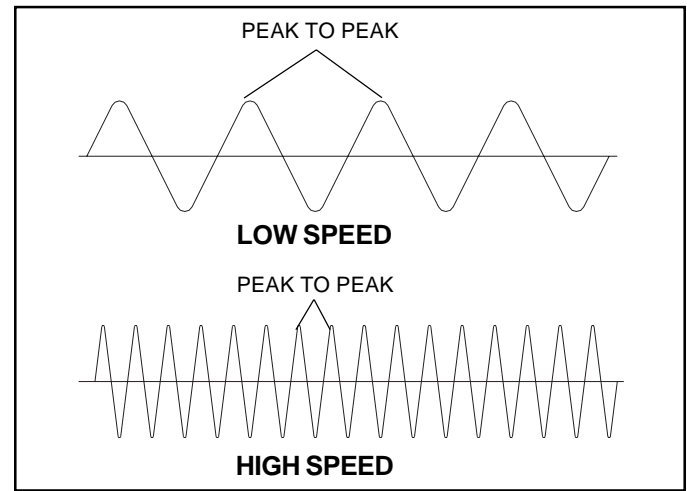


FIGURE 3 - SPEED SENSOR VOLTAGE CYCLE OUTPUT

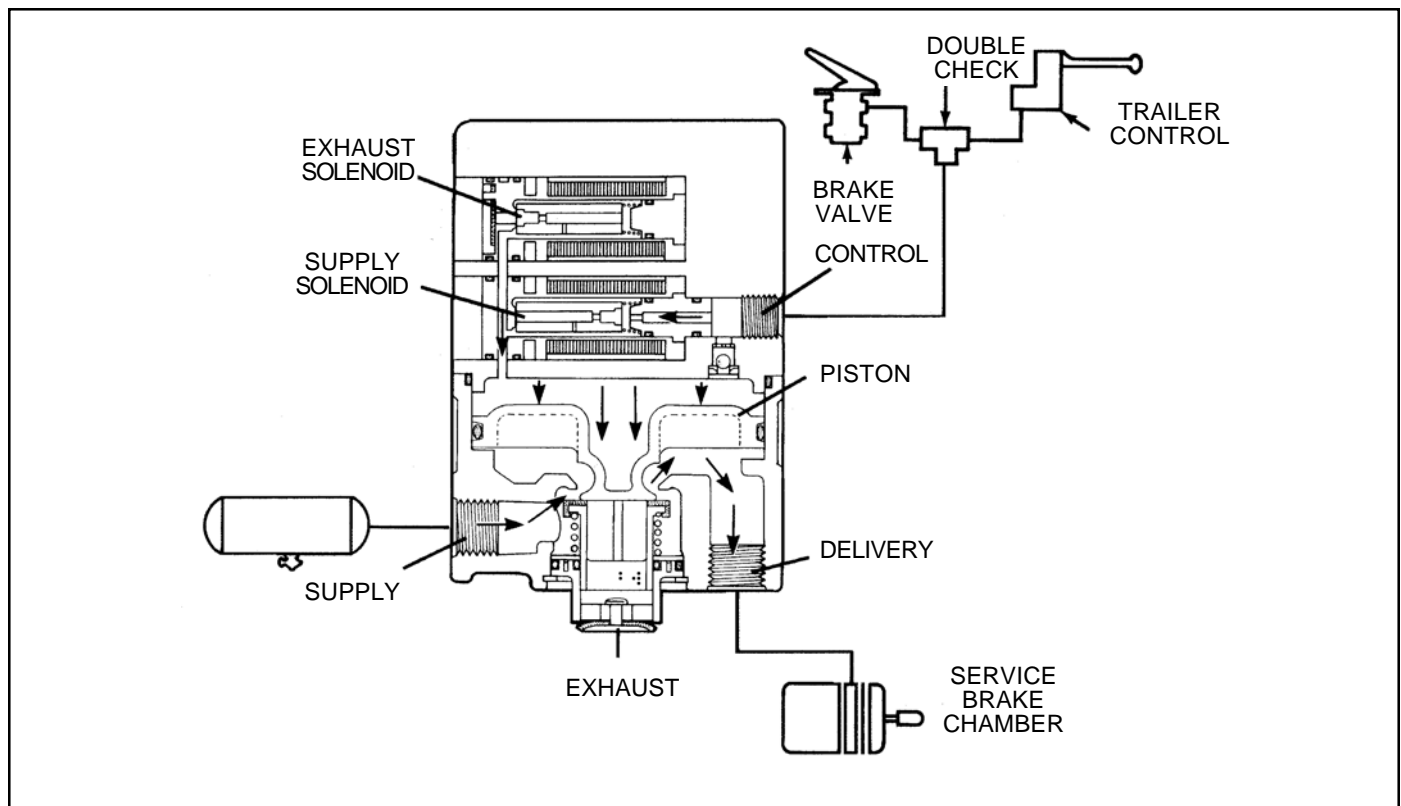


FIGURE 4 - APPLYING: NORMAL SERVICE APPLICATION

OPERATION

APPLYING: Normal Service Application

When a normal service brake application is made, and the EC-12™ controller does not sense impending wheel lock up, control air pressure from the brake valve enters the modulator

control port. The air passes through the supply solenoid and acts on the modulator's piston. The piston closes the modulator exhaust and opens the inlet, delivering supply air out the delivery ports.

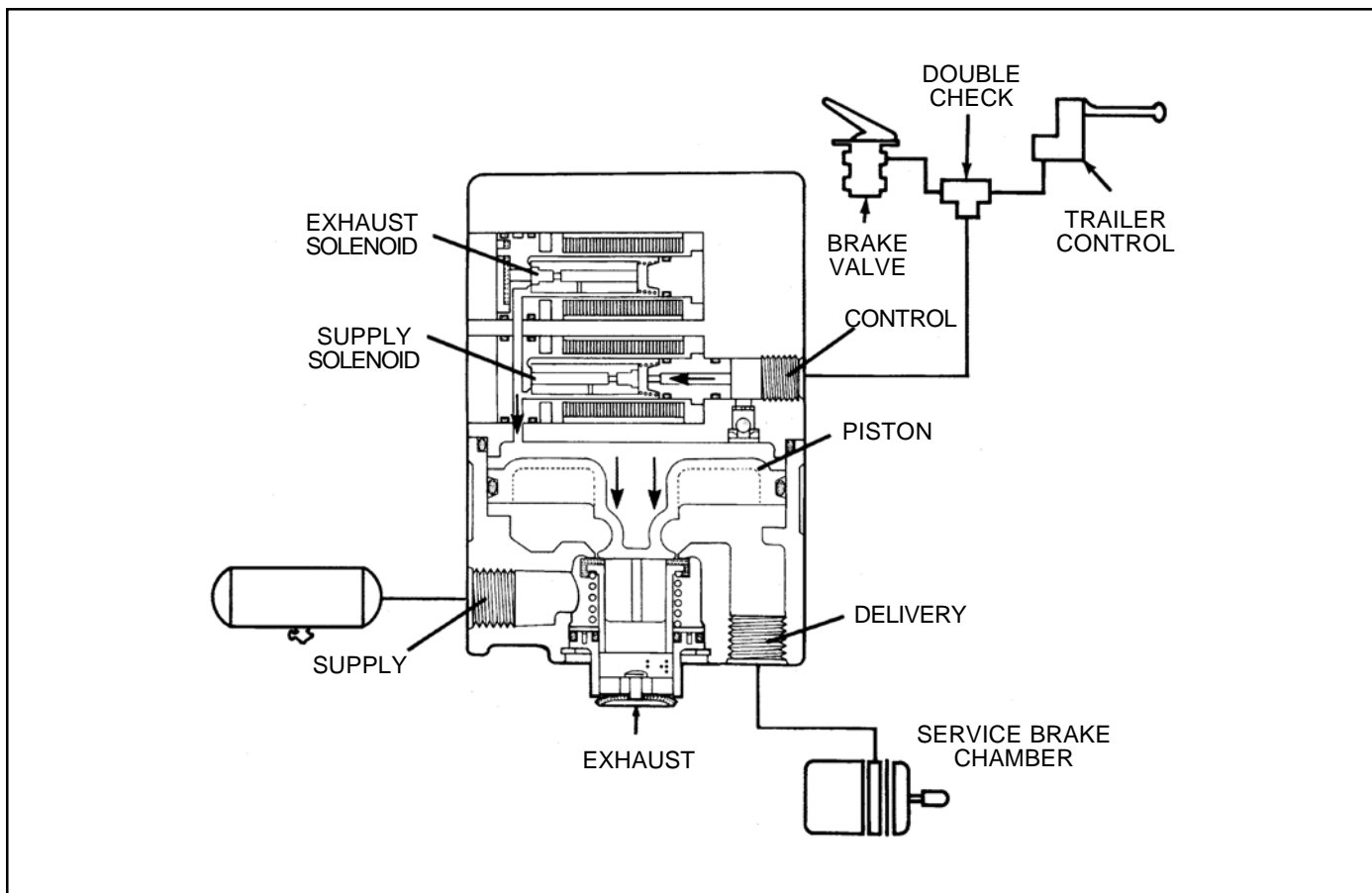


FIGURE 5 - **BALANCED POSITION: NORMAL SERVICE APPLICATION**

BALANCED POSITION: Normal Service Application

The modulator reaches a balanced position when control pressure acting upon the top side of the piston approaches that of the air acting upon the underside of the piston. The piston moves upward and closes the inlet valve, while the exhaust remains closed. This prevents the modulator from delivering or exhausting air.

When activated, shuttles within the solenoids alter the application and exhaust of control air pressure. The supply solenoid closes, preventing control line pressure from entering the modulator. Then the exhaust solenoid opens, allowing control pressure to exhaust from the top side of the piston through the exhaust port of the solenoid assembly. This activity occurs in a pulsating manner, simulating "pumping of the brakes."

EXHAUSTING: Normal Service Application

When the brake valve is released, control pressure exhausts through the supply solenoid and the check valve in the solenoid housing and out the exhaust port of the brake valve. As the piston moves upward, the modulator's exhaust opens, allowing air from the piston's underside to exhaust through the modulator exhaust port.

ANTILOCK MODE: Solenoids Activated

If a service brake application is made and the EC-12™ controller senses wheel lockup, it will command the antilock system to alter the service brake application.

PREVENTIVE MAINTENANCE

1. Every 3 months; 25,000 miles; or 900 operating hours perform SERVICE CHECKS.
2. Every twelve months; 100,000 miles; or 3600 operating hours, disassemble the relay valve portion of the M-12 Modulator and clean parts with mineral spirits. **DO NOT DISASSEMBLE THE SOLENOID ASSEMBLY.** Replace all rubber parts and any parts worn or damaged. Check for proper operation before placing vehicle in service.

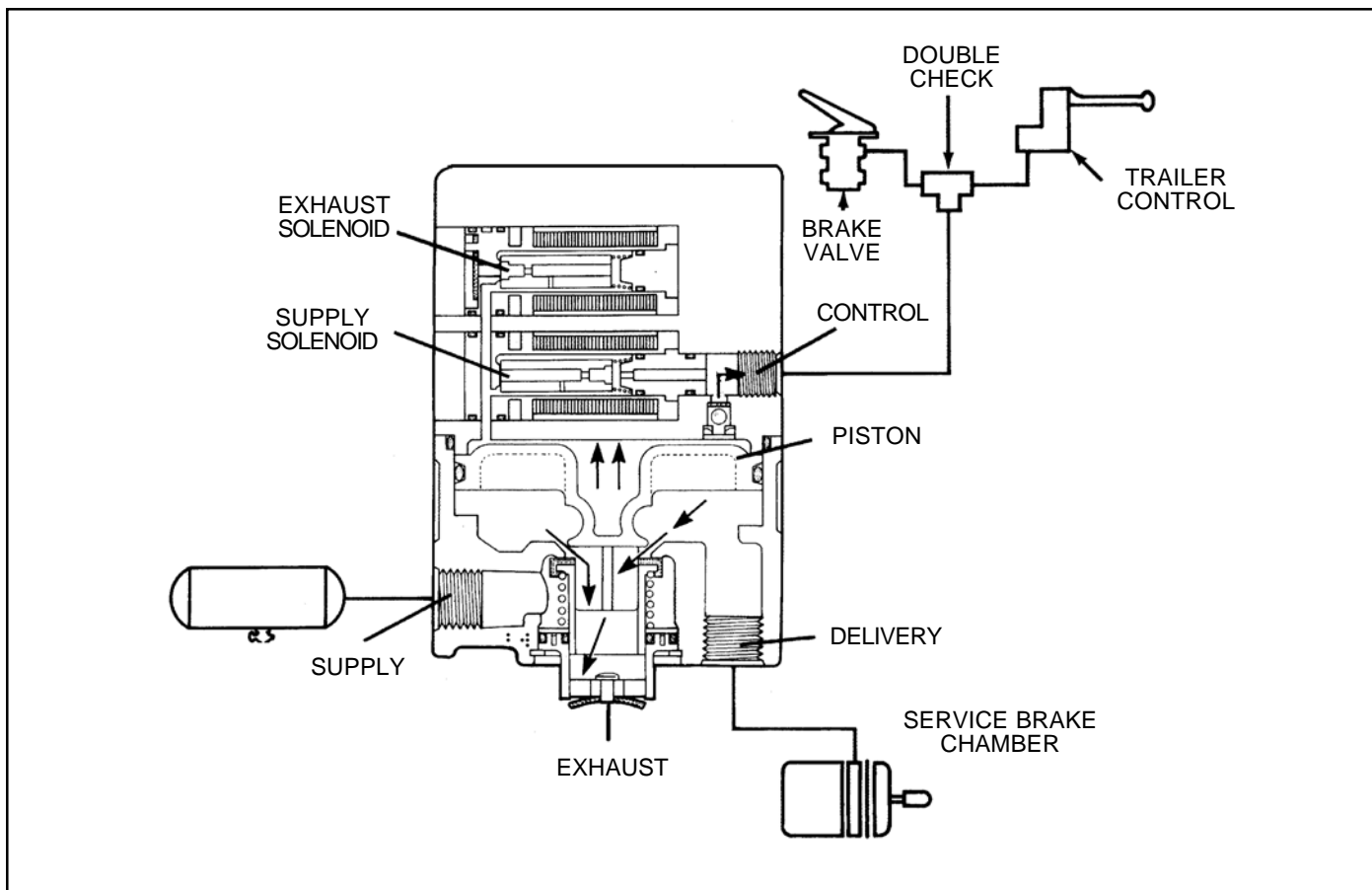


FIGURE 6 - EXHAUSTING: NORMAL SERVICE APPLICATION

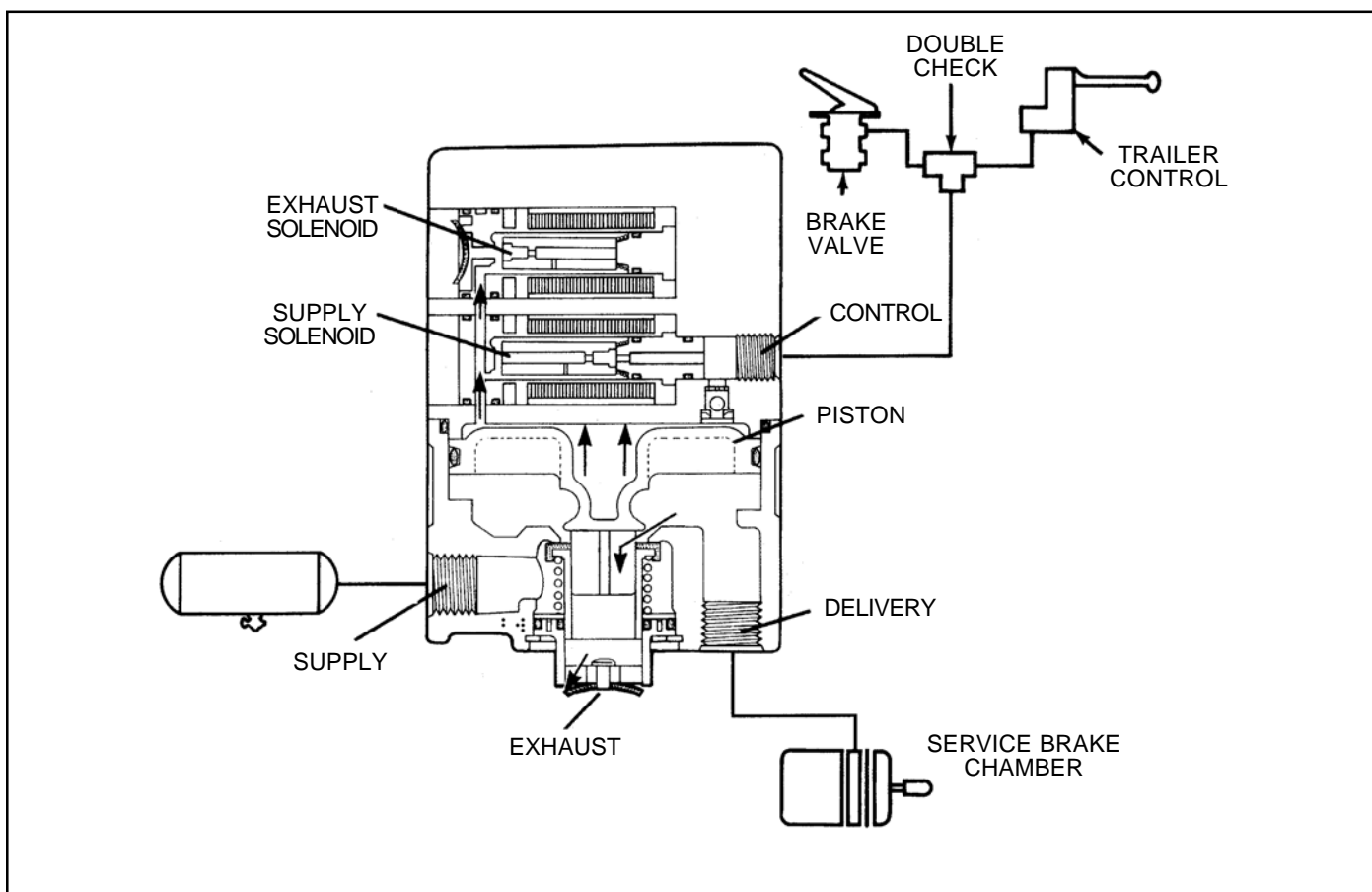


FIGURE 7 - ANTILOCK MODE: SOLENOIDS ACTIVATED

SERVICE CHECKS

Ensure that all wiring and connectors are secure and free from visible damage. Although the MC-12™ modulator assembly contains self check diagnostics, the LED (Light Emitting Diode) display should be inspected to ensure that the LEDs are functional. With the trailer brakes actuated, a magnet (800 gauss; capable of picking up 3 ounces) held to the LED reset area should cause all of the LEDs to illuminate. If one or more of the LEDs DO NOT ILLUMINATE and the optional status light indicates proper system function, the non illuminated LED(s) should be noted for future reference. Although the diagnostic capabilities will be limited, the system will continue to function as designed.

The MC-12™ modulator assembly monitors the electronics of the system upon initial trailer brake application. However, the vehicle should be road tested periodically to verify proper solenoid function. The solenoids can be tested by making an aggressive trailer stop from a speed of 20 m.p.h. When an antilock stop is made, solenoid pulsation creates an audible burst of air, which can be heard from the outside of the trailer.

WARNING! PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH:

When working on or around a vehicle, the following general precautions should be observed at all times.

1. Park the vehicle on a level surface, apply the parking brakes, and always block the wheels. Always wear safety glasses.
2. Stop the engine and remove ignition key when working under or around the vehicle. When working in the engine compartment, the engine should be shut off and the ignition key should be removed. Where circumstances require that the

engine be in operation, **EXTREME CAUTION** should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated or electrically charged components.

3. Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.
4. If the work is being performed on the vehicle's air brake system, or any auxiliary pressurized air systems, make certain to drain the air pressure from all reservoirs before beginning **ANY** work on the vehicle. If the vehicle is equipped with an AD-IS™ air dryer system or a dryer reservoir module, be sure to drain the purge reservoir.
5. Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that safely removes all electrical power from the vehicle.
6. Never exceed manufacturer's recommended pressures.
7. Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.
8. Use only genuine Bendix® replacement parts, components and kits. Replacement hardware, tubing, hose, fittings, etc. must be of equivalent size, type and strength as original equipment and be designed specifically for such applications and systems.
9. Components with stripped threads or damaged parts should be replaced rather than repaired. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle and component manufacturer.
10. Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.

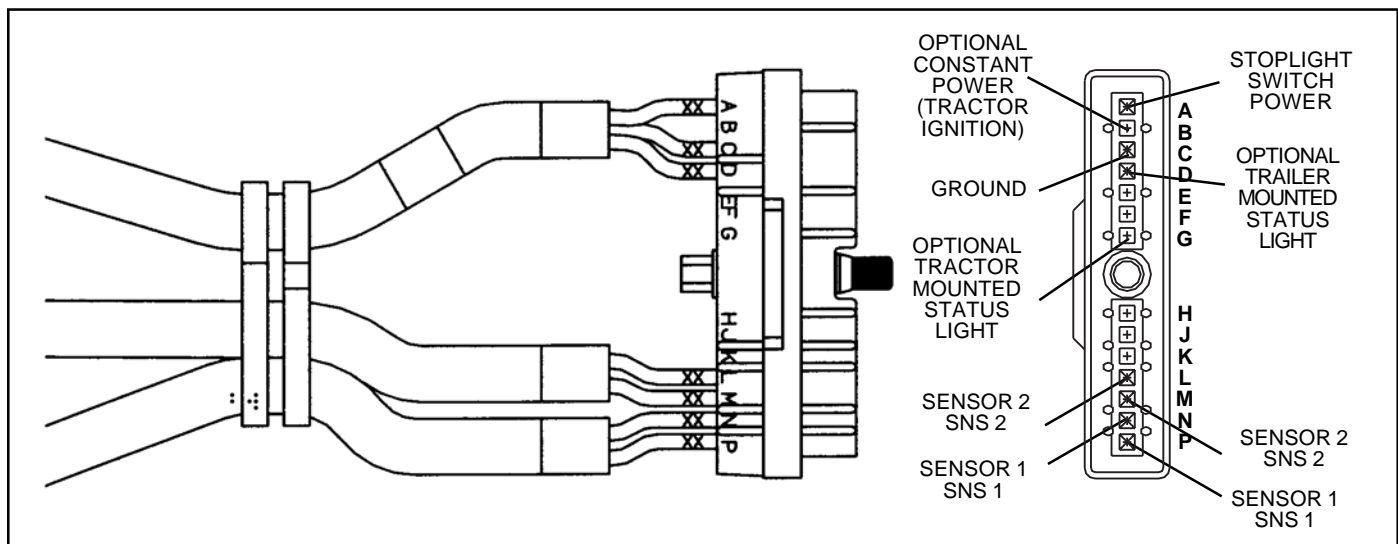


FIGURE 8 - ELECTRICAL CONNECTOR

REMOVAL OF THE MC-12™ MODULATOR ASSEMBLY

1. Remove and identify all air lines connected to the unit.
2. Disconnect the 14 pin connector from the unit by loosening its screw and pulling the connector away from its socket.
3. Remove and save the mounting hardware connecting the MC-12™ modulator to the vehicle.
4. Prior to disassembly, remove as much contamination as possible from the exterior of the assembly. Be sure to keep the contamination away from the open ports.

INSTALLATION OF THE MC-12™ MODULATOR ASSEMBLY

1. Replace the MC-12™ modulator assembly on the vehicle using the hardware saved during removal. Connect the air lines to the proper ports, as identified during removal. Connect the 14 pin connector into the controller and tighten the screw.

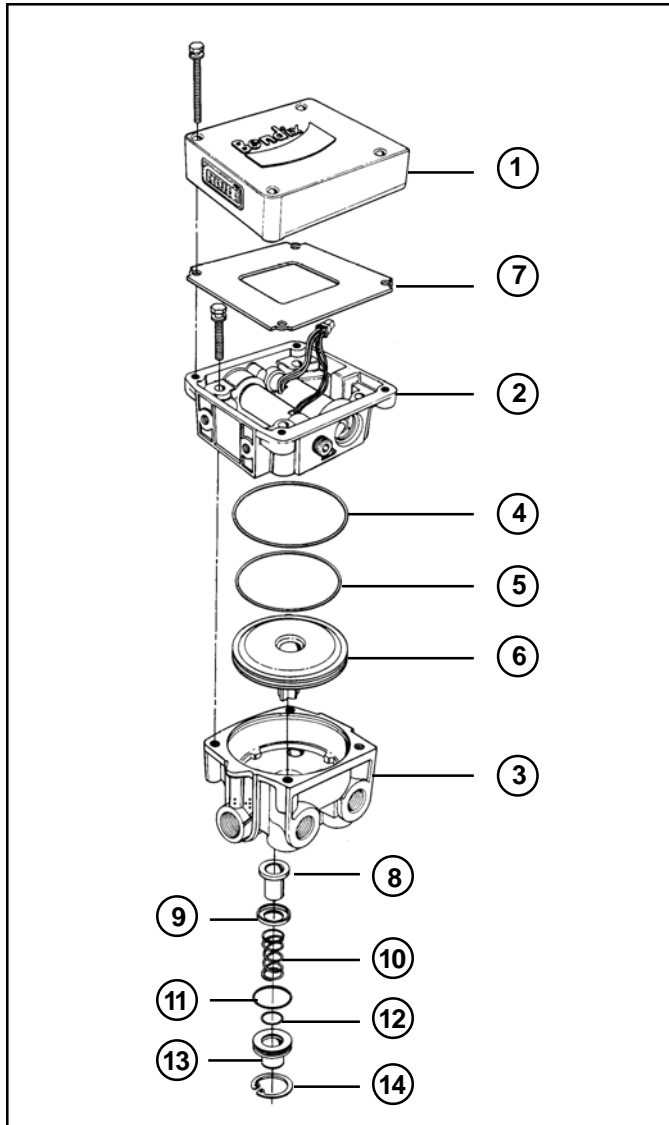


FIGURE 9 - EXPLODED VIEW

DISASSEMBLY

The following disassembly and assembly procedure is presented for reference purposes and presupposes that a major rebuild of the antilock valve is being undertaken. Several replacement parts and maintenance kits are available which do not require full disassembly. The instructions provided with these parts and kits should be followed in lieu of the instructions presented here.

CAUTION: The MC-12™ modulator may be lightly clamped in a bench vise during disassembly. However, over clamping will result in damage, leakage, and/or malfunction. If a vise is to be used, position the MC-12™ modulator so the jaws bear on the flat area of the supply port and its opposing side of the body.

1. Remove the EC-12™ controller (1) from the M-12™ modulator by removing the controller's four mounting bolts.
2. Lift the controller off the M-12™ modulator and detach the wire harness from the base of the controller by depressing the lock tab on the side of the connector and pulling the connector from its socket in the controller. Remove the gasket (7) from the EC-12™ controller body. NOTE: If replacement of the controller only is required, proceed to Step 8 of assembly.
3. Remove sealing ring (4) from the protrusion on the bottom of the solenoid assembly.
4. Using a pair of snap ring pliers, remove retaining ring (14). Remove the exhaust assembly (13). Remove o-ring (12) and o-ring (11) from the I.D. and O.D., respectively, of the exhaust assembly.
5. Remove spring (10). Remove the inlet/exhaust assembly (8). Remove the spring seat (9) from the inlet/exhaust assembly.
6. Using your thumb, press the piston stem and push the piston (6) out the opposite end of the body. Remove o-ring (5) from the piston.
7. Discard all items that have replacement parts in the maintenance kit.

CLEANING & INSPECTION

1. Using mineral spirits or an equivalent solvent, clean and thoroughly dry all parts to be reused. Do not allow mineral spirits to come into contact with the ECU connector or solenoids.
2. Inspect the interior and exterior of all parts that will be reused for severe corrosion, pitting and cracks. Superficial corrosion and/or pitting on the exterior portion of the body is acceptable.
3. Inspect the bores for deep scuffing or gouges.
4. Inspect the pipe threads in the body. Make certain they are clean and free of thread sealant.

5. Inspect all air line fittings and plugs for corrosion. Clean all old thread sealant from the pipe threads.

Any component exhibiting a condition described in inspection steps 2 to 5 should be discarded and replaced before proceeding.

ASSEMBLY—REFER TO FIG. 9

1. Using a lubricant (Bendix Pc. No. 291126) lightly coat all o-rings and the bores of the valve body.
2. Install spring seat (9) onto the inlet/exhaust valve (8) so that it covers the rubber seat of the inlet/exhaust valve. Place the inlet/exhaust valve, large diameter first, into the M-12™ modulator's bottom bore.
3. Install spring (10) over the barrel of the inlet/exhaust valve (8) so that one end of the spring rests on the spring seat (9).
4. Install the o-rings (11 & 12) into the respective grooves of the O.D. and I.D. of the exhaust assembly (13). Place the large diameter of the exhaust assembly against the spring (10) and compress the spring until the exhaust assembly enters the bore of the body and the o-ring (11) seals against the wall of the bore.
5. Depress the exhaust assembly into the bore until it exposes the groove for the snap ring (14). Install snap ring (14) into its groove. Make sure it is fully seated.
6. Install o-ring (5) into its groove in the piston (6). Install piston (6) into the M-12™ modulator body. The piston stem fits into the small hole in the center of the body.
7. Install o-ring (4) onto the protrusion on the bottom of the M-12™ modulator solenoid assembly. Install the solenoid assembly (2) onto the valve body. The solenoid assembly will fit on the M-12™ modulator body in any of four orientations, 90 degrees apart. However, if clearance is a problem, make sure the control port is not directly above the valve's supply port, which will be nipple mounted to a reservoir. Secure the solenoid assembly to the valve body with the four 1/2" bolts. Torque the bolts to 120 150 in. lbs.
8. Install gasket (7) onto the EC-12™ controller. Install the EC-12™ controller (1) as shown in Figure 9 by plugging the electrical connector from the solenoid assembly into the socket in the bottom of the controller. Press in until lock tab engages. Ensure engagement by pulling the connector lightly. Place the controller onto the solenoid assembly and secure with the four 1/2" bolts and lock washers. Torque to 30 60 in. lbs.

OPERATIONAL AND LEAKAGE TEST

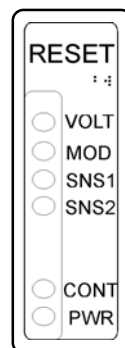
1. Chock wheels. Fully charge air brake system and adjust brakes.

2. Make several trailer brake applications and check for prompt application and release at each wheel.
3. Check for inlet valve o-ring leakage. With the trailer service brakes released, coat the exhaust port and the area around the retaining ring with a soap solution. A 1" bubble in 3 seconds is permitted.
4. Check for exhaust valve leakage. With the trailer service brakes fully applied, coat the exhaust port with a soap solution. A 1" bubble in 3 seconds is permitted. Coat the outside of the modulator body to check for seal ring leakage. No leakage is permitted.
5. If leakage is excessive around the supply and exhaust solenoids, replace the M-12™ modulator. If excessive leakage is detected where the solenoid assembly and M-12™ modulator body meet, replace the M-12™ modulator. If excessive leakage is detected at the exhaust port, before replacing the M-12™ modulator perform the following test:

Place the vehicle in park by exhausting the air pressure from the emergency side of the spring brake. Perform the leakage check around the exhaust. If the air continues to leak out the exhaust replace the M-12™ modulator. If a leak exists between the emergency and service sides of the spring brake, the leakage at the exhaust will cease when air pressure is exhausted from the emergency side of the spring brake. The air pressure will pass from the emergency side to the service side of the chamber, out the service inlet and out the M-12™ modulator exhaust.

ELECTRICAL TEST

If the status light remains on after the trailer brakes have been actuated, inspect the EC-12™ controller for illuminated LEDs. Each LED represents a specific area.



| | |
|-----------------|---------------------------|
| VOLT LED (red) | High/Low Voltage |
| MOD LED (red) | M-12™ Modulator Failure |
| SNS1 LED (red) | Wheel Sensor Failure |
| SNS2 LED (red) | Wheel Sensor Failure |
| CONT LED (red) | EC-12™ Controller Failure |
| PWR LED (green) | EC-12™ Controller Power |

RED LEDs INDICATE FAILURE

When the EC-12™ controller senses a failure, the red LED corresponding to the failure mode will illuminate. A failure is stored in memory until the problem is repaired and the EC-12™ controller is reset. NOTE: Only the voltage LED resets itself after the condition no longer exists.

TROUBLESHOOTING INFORMATION

PREPARATION FOR TESTING

All trailer antilock testing should be performed with a tractor connected to the trailer.

1. Connect the tractor to the trailer and build up the air system, on both the tractor and trailer, to governor cut out pressure.
2. Park the combination on a level surface. Apply the tractor parking brakes then **release the trailer parking brakes only** and turn off the engine.

NOTE: Some tractors may not have the ability to release the trailer brakes while the tractor parking brakes remain applied. In this event, chock all wheels, build the tractor and trailer system to governor cut out and turn off the engine without applying the parking brakes.

TROUBLESHOOTING

GENERAL

While the EC-12™ controller diagnostic display locates a specific problem area, it is still necessary to confirm whether the problem resides in the component itself or the wiring. Basically the troubleshooting procedure that follows is

devoted to narrowing the problem to either the wiring or a specific antilock component. It should be noted that ALL TROUBLESHOOTING BEGINS BY OBSERVING THE ANTILOCK STATUS LAMP ON THE TRAILER WHILE PERFORMING THE "INITIAL START-UP PROCEDURE" and following the directions contained in the procedure.

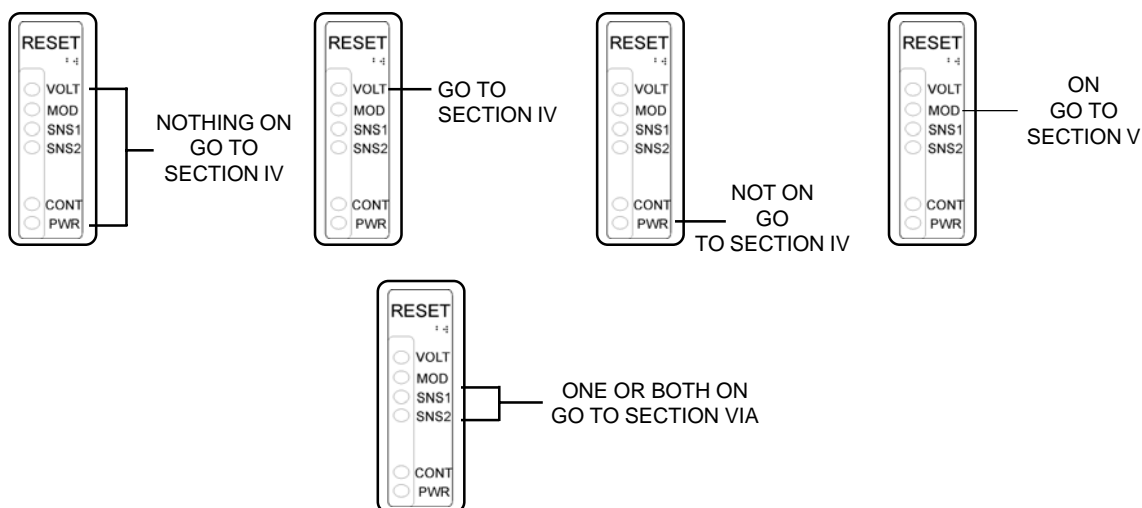
Be sure to record a failure before resetting the system. Reset by holding a magnet (capable of picking up 3 ounces) over the reset location on the diagnostic window. If the LED(s) do not clear during a reset, check all wiring and hardware per the troubleshooting chart (BWS 1082). During a reset, all LEDs will illuminate until the magnet is removed.

IMPORTANT - TROUBLESHOOTING TIPS

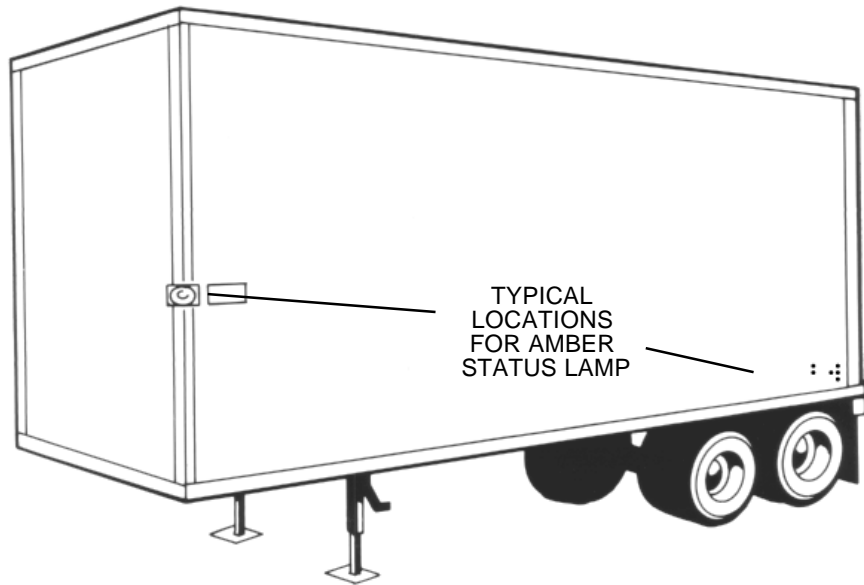
1. Record all findings and the action taken during the troubleshooting process. The record sheet should be filed in the trailer maintenance folder for future reference and comparison.
2. No voltage or resistance tests are performed into the EC-12™ controller. All voltage and resistance tests are performed by beginning at the wire harness half of the connector and moving AWAY from the EC-12™ controller toward an antilock system component (modulator, wheel speed sensor, etc.)

DIAGNOSTIC DISPLAY QUICK REFERENCE

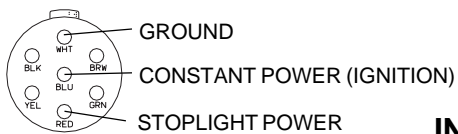
This index is presented for the benefit of personnel experienced in troubleshooting Bendix® MC-12™ trailer antilock system. It provides a quick reference to specific sections that provide testing procedures and values.



TYPICAL 7 PIN TRAILER ELECTRICAL CONNECTOR

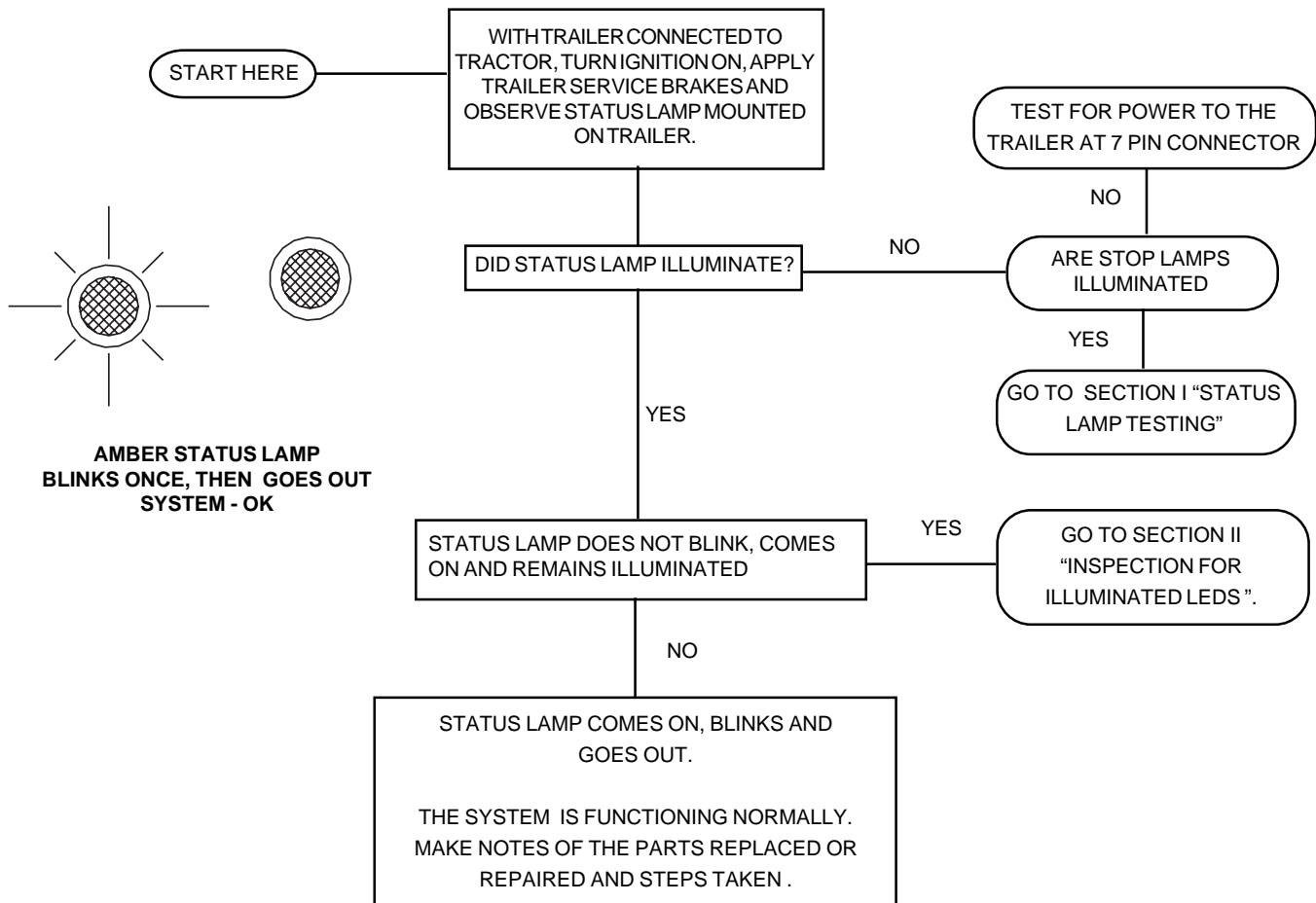


7 PIN TRAILER CONNECTOR



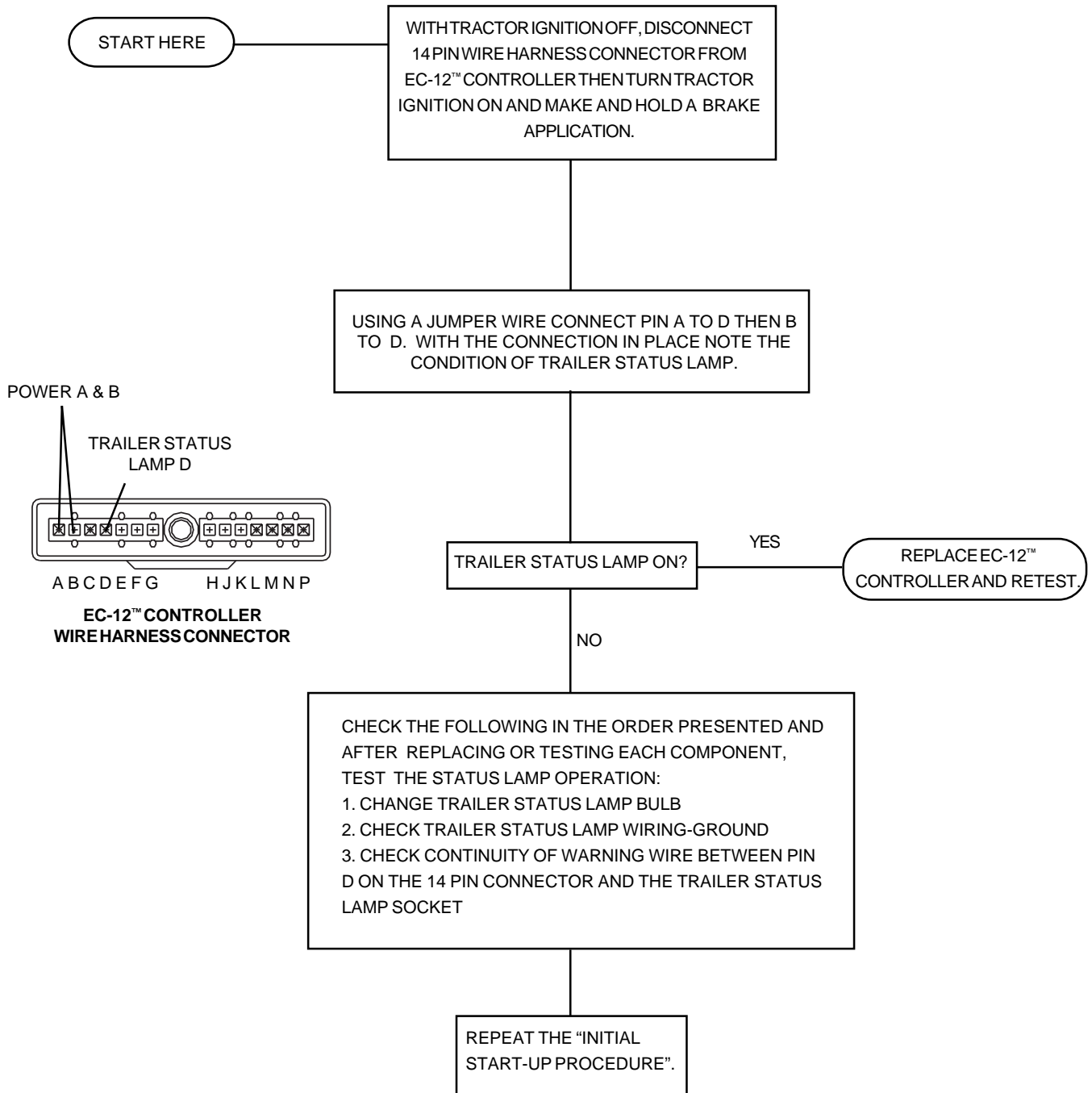
Troubleshooting

INITIAL START-UP PROCEDURE



Troubleshooting

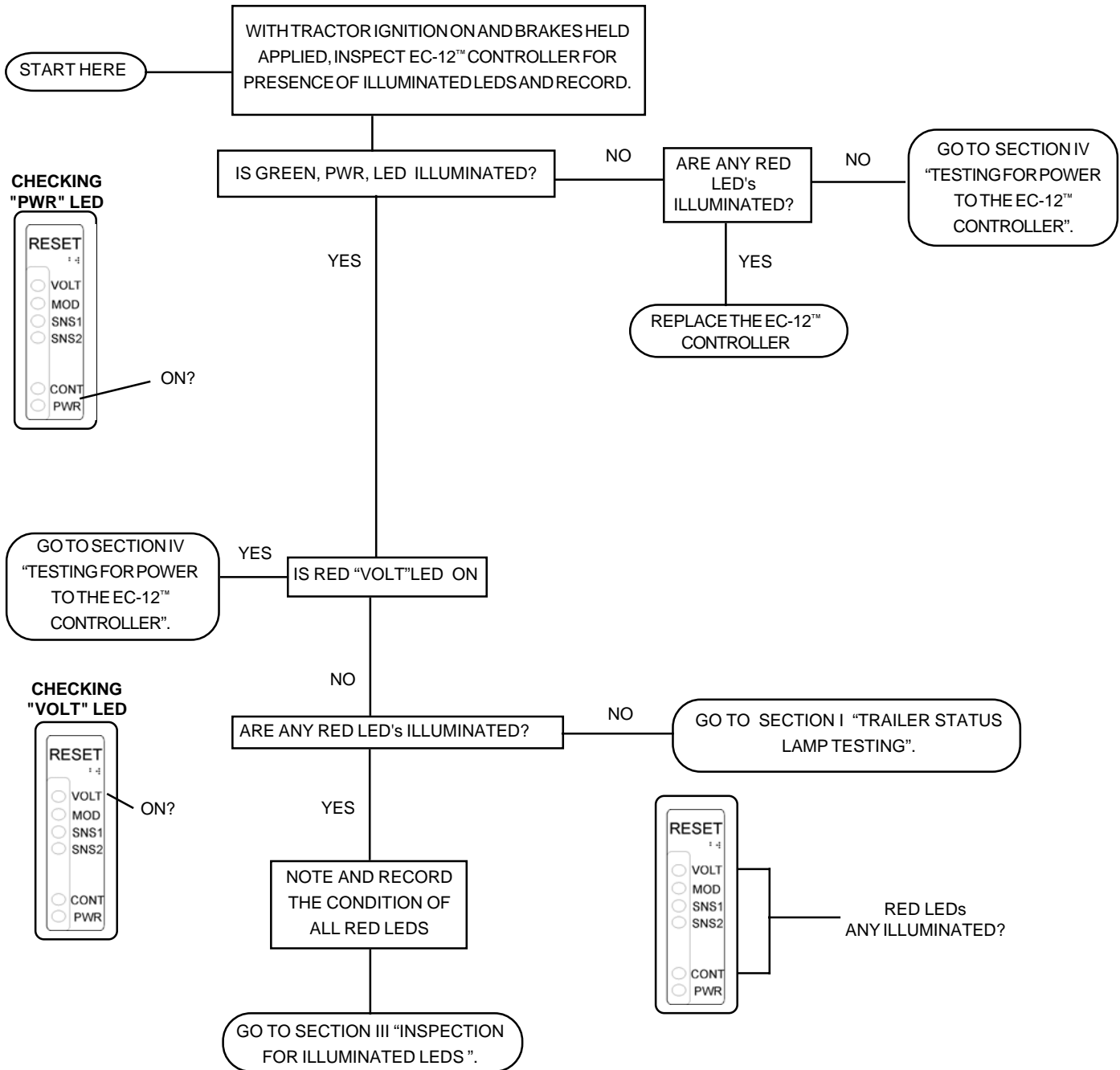
SECTION I TRAILER STATUS LAMP TESTING



Troubleshooting

SECTION II

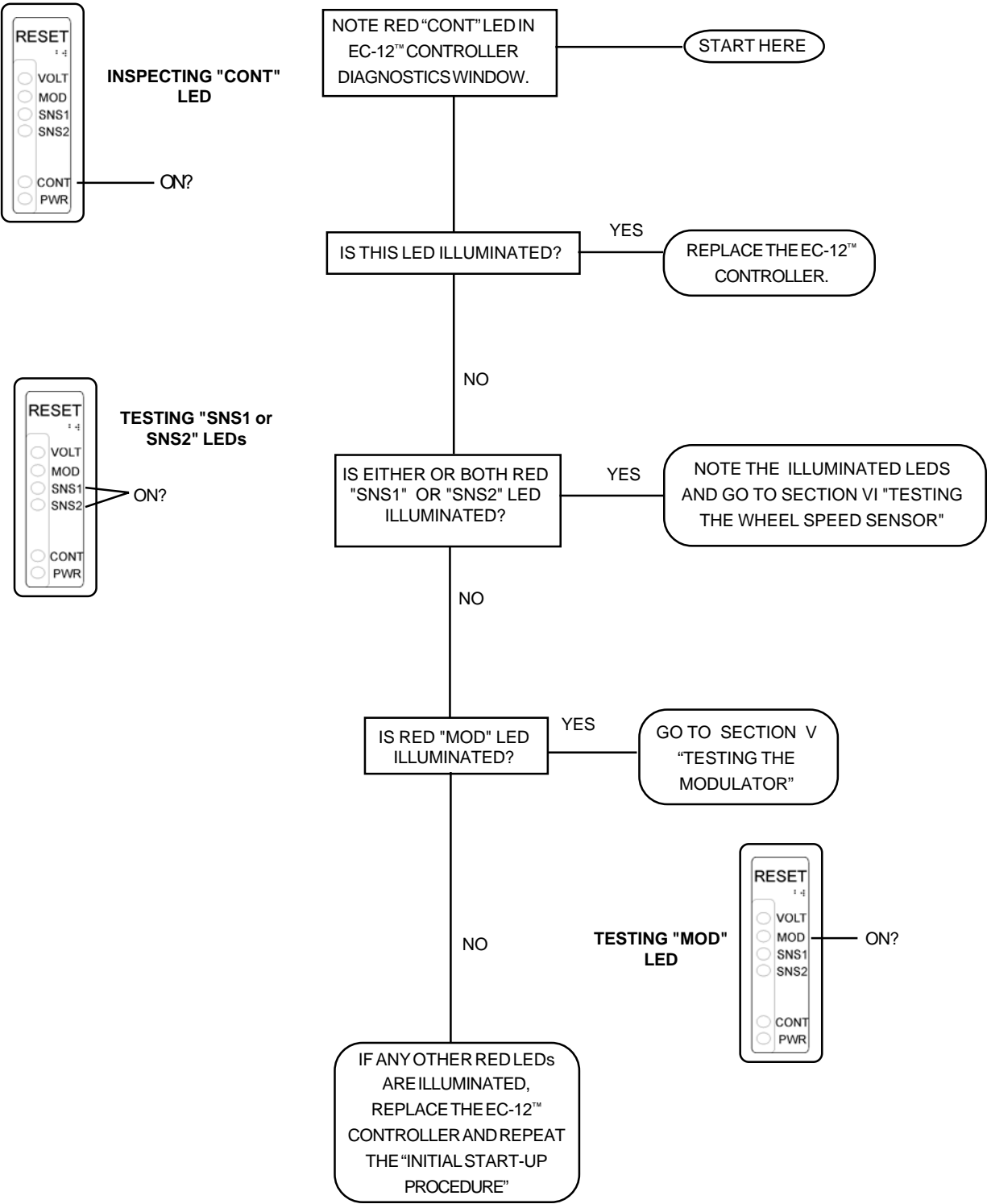
INSPECTION FOR ILLUMINATED LED's



Troubleshooting

SECTION III

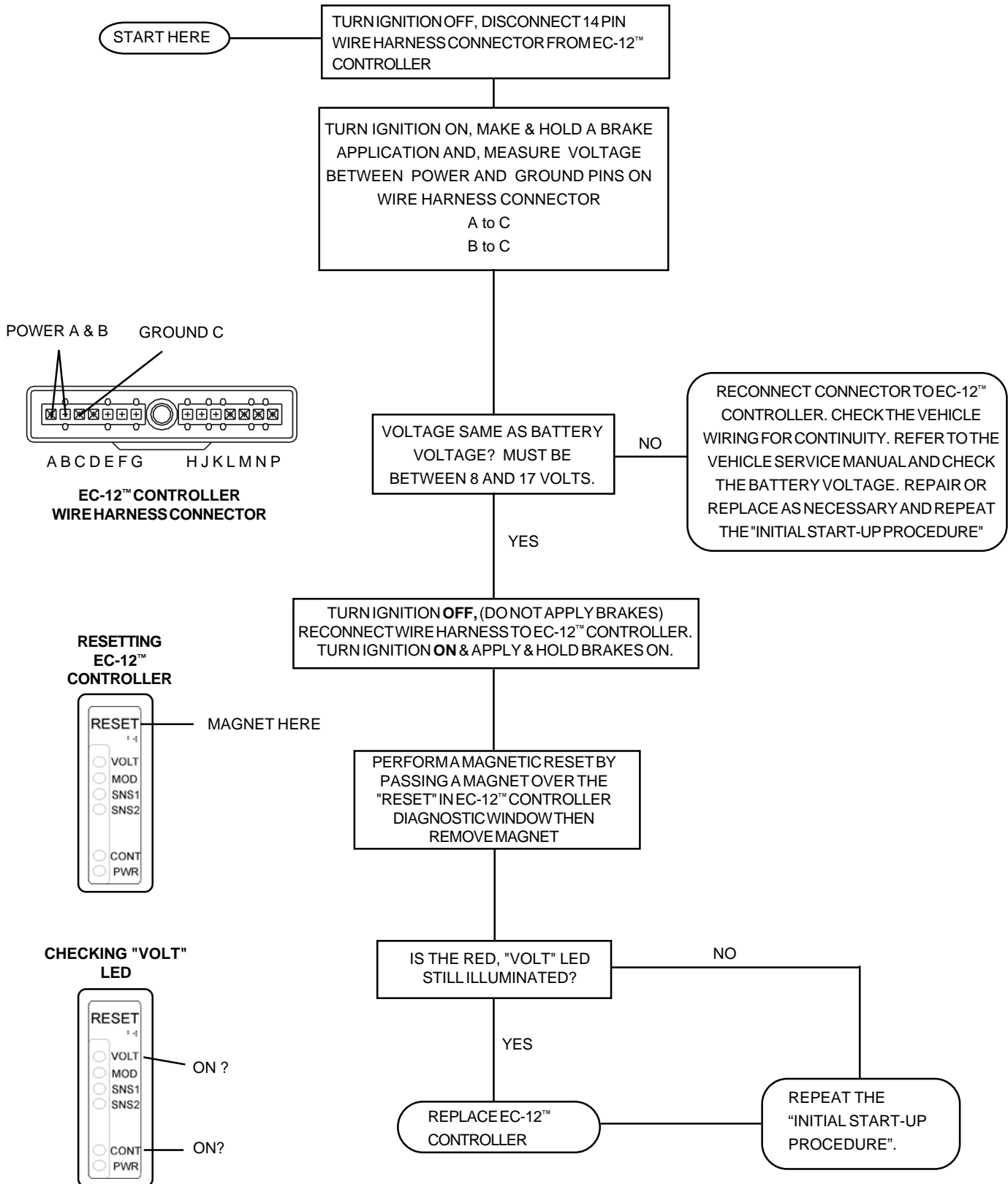
INSPECTION FOR ILLUMINATED LEDs



Troubleshooting

SECTION IV

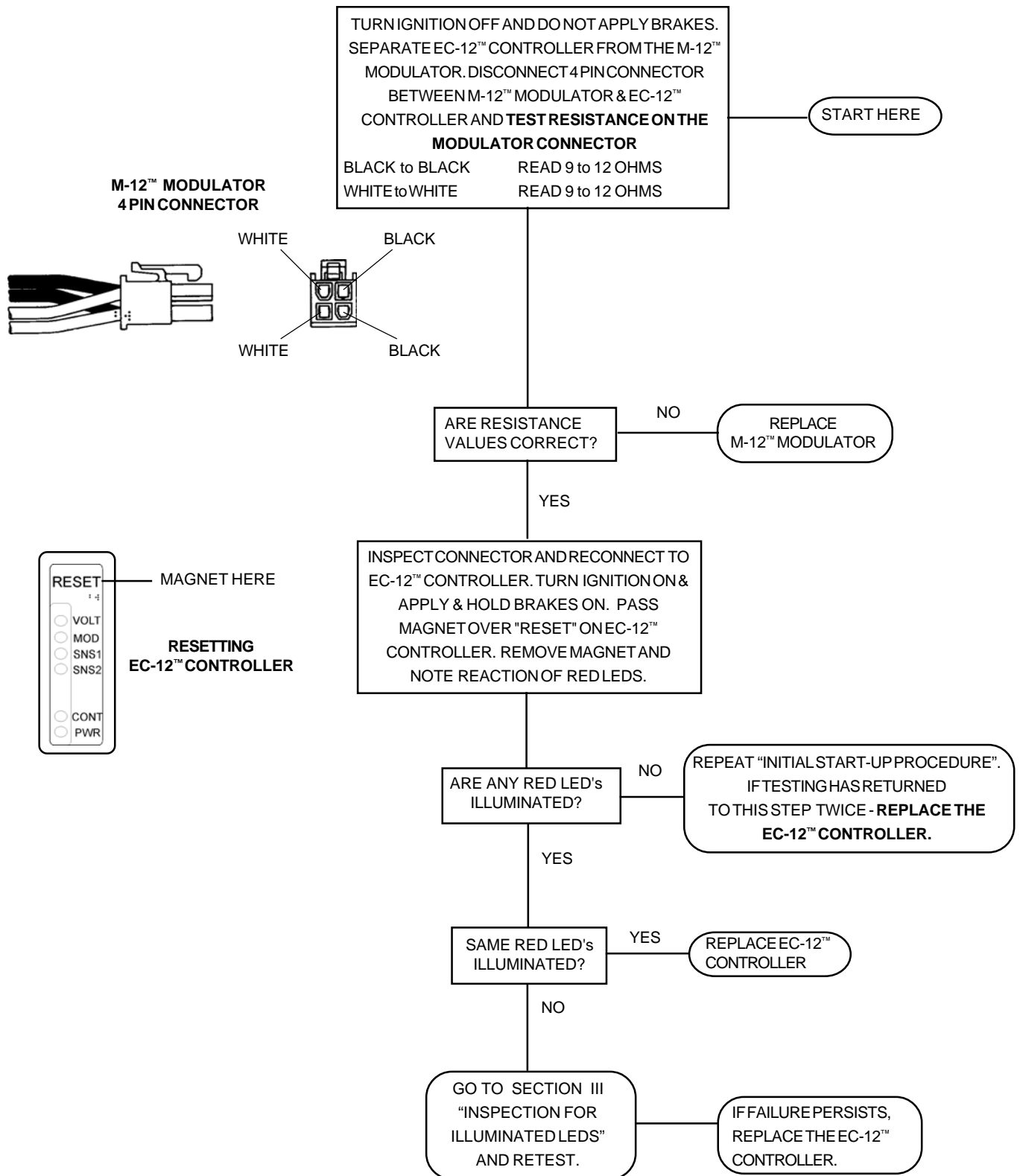
TESTING FOR POWER TO THE EC-12™ CONTROLLER



Troubleshooting

SECTION V

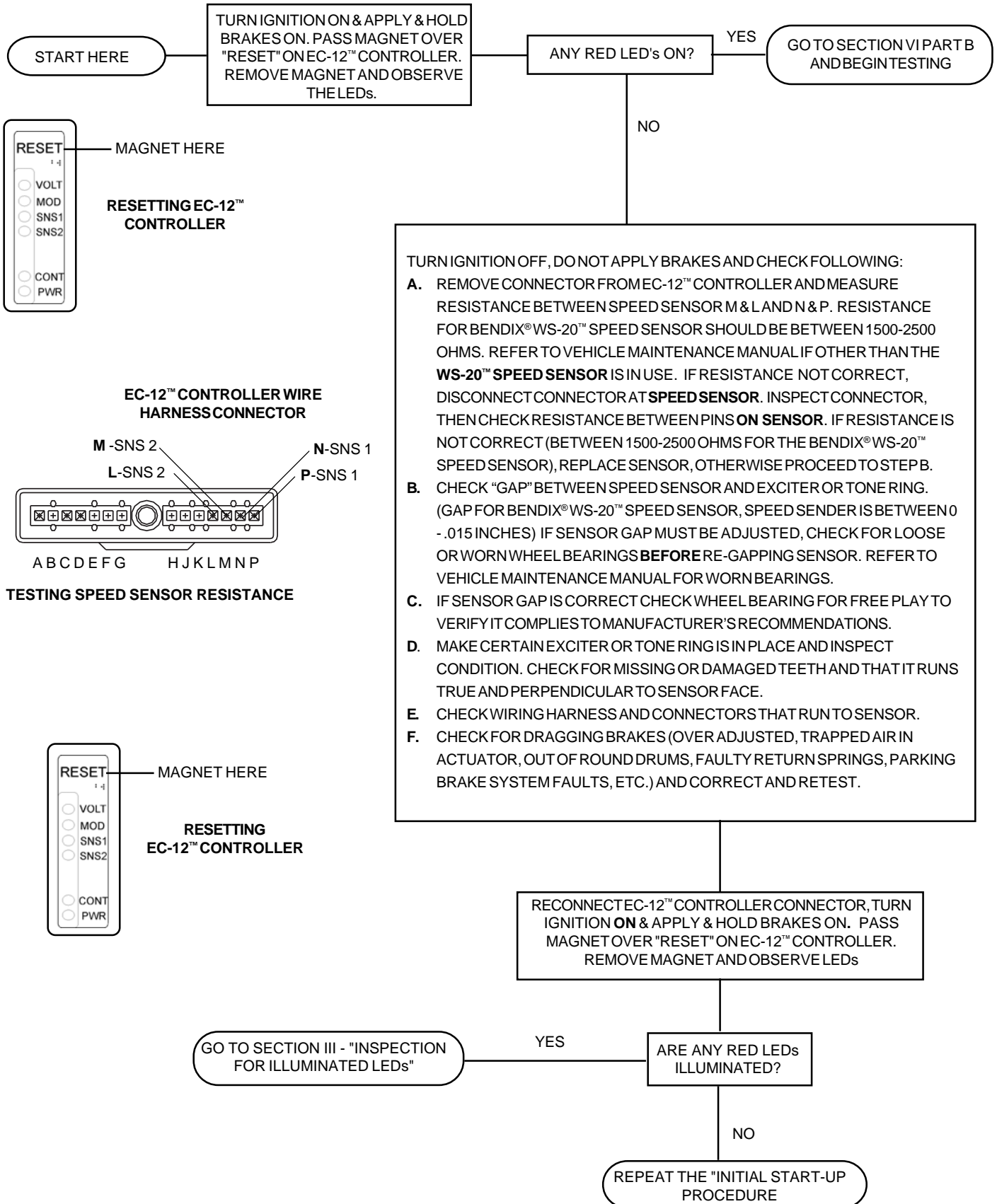
TESTING THE MODULATOR



Troubleshooting

SECTION VI PART A

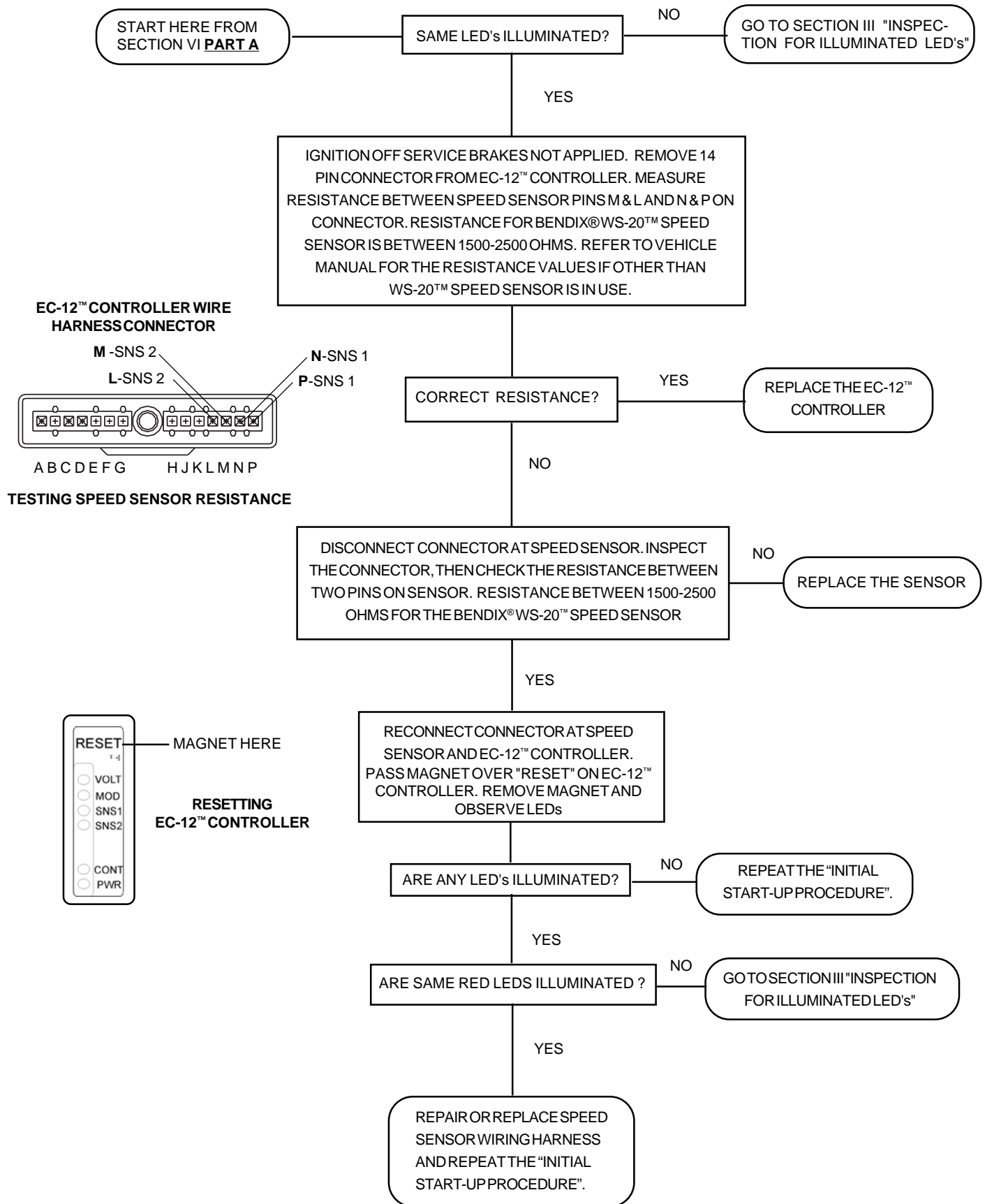
TESTING THE WHEEL SPEED SENSOR



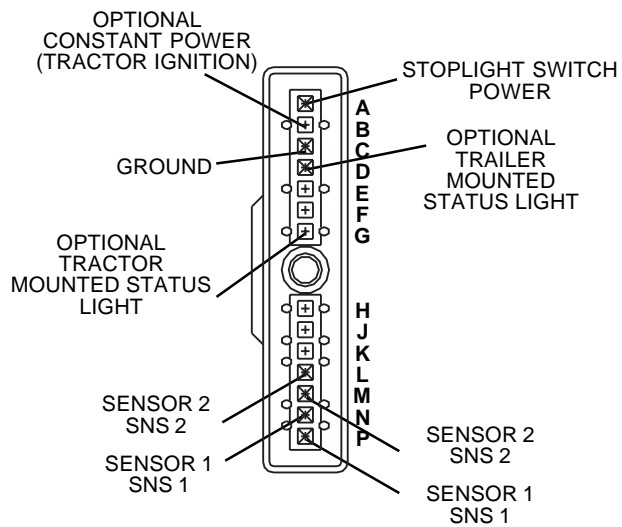
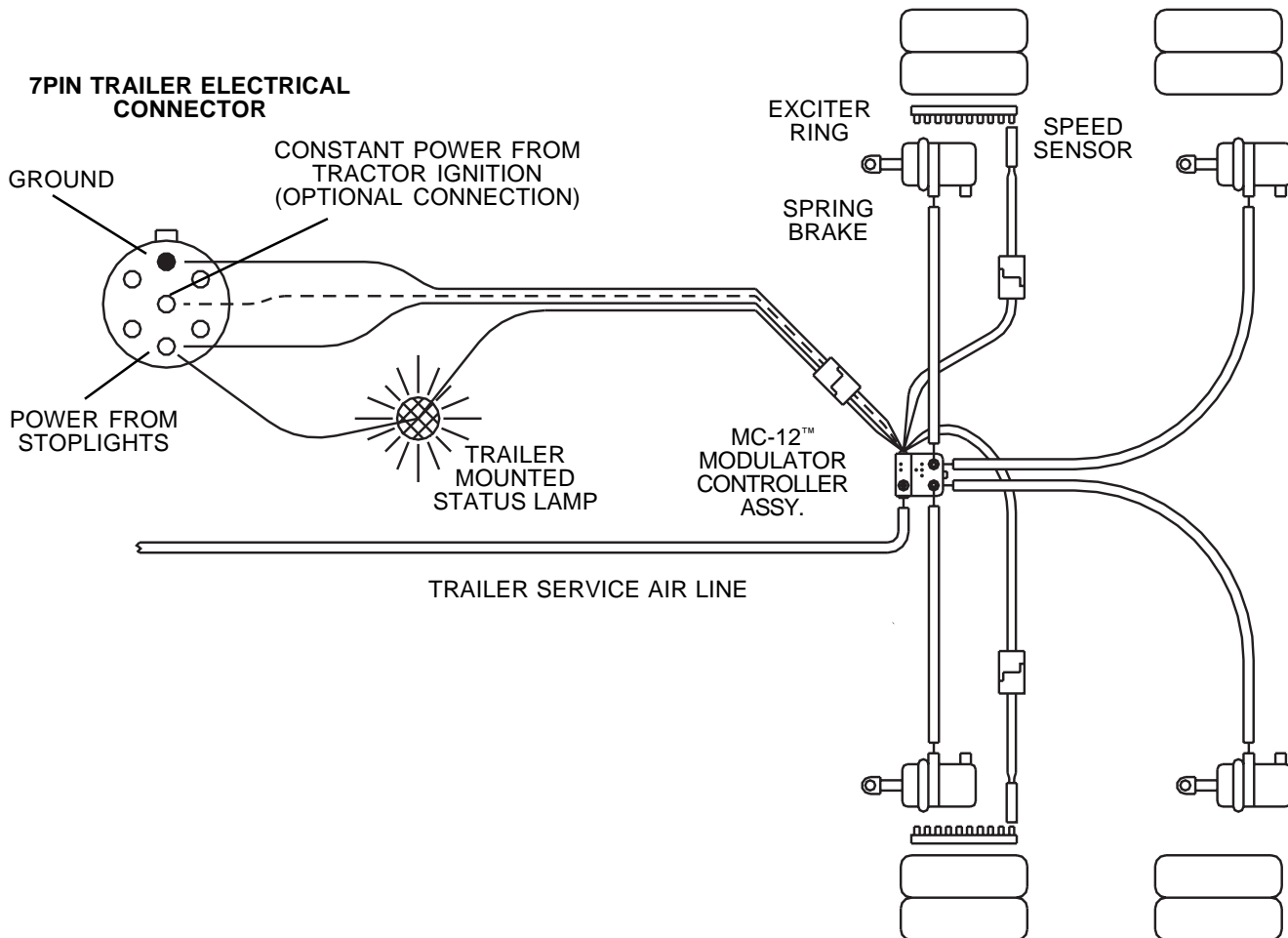
Troubleshooting

SECTION VI PART B

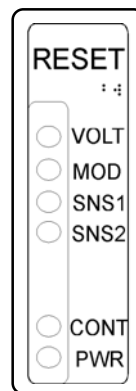
TESTING THE WHEEL SPEED SENSOR



NOTES & REFERENCES



14 PIN EC-12™ CONTROLLER CONNECTOR



EC-12™ CONTROLLER DIAGNOSTIC WINDOW

| | | |
|----------|---------|---------------------------|
| VOLT LED | (red) | High/Low Voltage |
| MOD LED | (red) | M-12™ Modulator Failure |
| SNS1 LED | (red) | Wheel Sensor Failure |
| SNS2 LED | (red) | Wheel Sensor Failure |
| CONT LED | (red) | EC-12™ Controller Failure |
| PWR LED | (green) | EC-12™ Controller Power |

NOTES & REFERENCES

